

is itself invisible, but is very strongly defined by the deep undulated furrow, which at the top of the whorls sinks in behind the longitudinal ribs and cuts them off from the base of the preceding whorl. *Mouth* oval, rather small, deep, perpendicular, and very little oblique; from its lower left corner rises a strong, deep, equal, slightly curved canal, whose direction is distinctly, but not strongly, to the left. *Outer lip*: its nearly semicircular curve is slightly flattened about the middle, and bags a little toward the lower outer corner; at its upper corner it advances a good deal and rises a little on the body-whorl; its sharp and contracted margin, which projects from the last and massive varix, is crenulated; remote from the edge it is scored by 9 rather long, narrow, sharp-topped teeth, the first and two last of which are stronger than the rest; the first is a little remote from the upper angle of the mouth, while the last is on the very edge of the canal. *Inner lip* spreads patulously, but not broadly, on the body-whorl in a thin, defined, porcellanous layer; it runs straight down the pillar as a sharp projecting edge; it is scored within by about 9 teeth, of which the first is short and strong, the second long and strong, the third and fourth long and weak, the fifth, sixth, and seventh short and weak, while the eighth and ninth are strong and coil round the point of the pillar. On the left side of the canal are 4 or 5 tubercles. H. 1.37. B. 0.84. Penultimate whorl, height 0.26. Mouth, height (exclusive of canal) 0.49, breadth 0.3. Length of canal 0.29, breadth 0.07.

This species has much resemblance to *N. acuminata*, Rve., but is shorter, squatter, coarser, with more ribs, is deeper in suture; the canal is shorter, more recurved, and more twisted.

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Notes on British Tunicata, with Descriptions of new Species.

I. Ascidiidæ. By W. A. HERDMAN, D.Sc. Edinb.

[Communicated by Sir Wyville Thomson, F.R.S., F.L.S.]

[Read December 2, 1880.]

(PLATES XIV.-XIX.)

THE family Ascidiidæ comprises those Simple Ascidians which have a six-, seven-, or, more generally, an eight-lobed branchial aperture and a six-lobed atrial aperture, the principal additional characters being:--body sessile, attached; tentacles simple, fili-

form; branchial sac not folded and having internal longitudinal bars. Excluding the genera *Chelyosoma* and *Rhodosoma* (*Chrevreulius*, Lac.-Duth.), which have not been found in our seas, the family, as represented by British species, corresponds to *Ascidia* as used by Forbes ('British Mollusca' &c.), and includes the three modern genera *Ciona*, *Ascidia*, and *Corella*, the first and third containing each several, and *Ascidia* a large number of species. *Ciona* and *Corella* have a series of languets along the dorsal edge of the branchial sac, while *Ascidia* has a continuous lamina; *Ciona* and *Ascidia* have the stigmata of the branchial sac straight, while those of *Corella* are curved. In addition to these and some other less important points, the three genera differ in the course and position of the alimentary canal from the œsophageal opening onwards; in *Ciona* (woodcut, fig. 1) it extends beyond the branchial sac posteriorly, while in the other two genera it lies alongside the branchial sac, on the right side in *Corella* (woodcut, fig. 2), and on the left in *Ascidia* (woodcut, fig. 3).

Alder first, in 1863 (Ann. & Mag. Nat. Hist. ser. 3, vol. xi. p. 158), pointed out that the intestine in *Corella* (then *Ascidia*) *parallelogramma*, after leaving the stomach, turned posteriorly\*, and not anteriorly as in *Ascidia*. This peculiarity, however, does not affect the relation of the intestine to the hæmal system; in both cases the curve is away from the heart. Hancock, in characterizing *Corella* (Ann. & Mag. Nat. Hist. ser. 4, vol. vi. p. 362, 1870), after describing the course of the alimentary canal, stated that it was very differently disposed from that of *Ascidia*, and that the heart occupied a different position. The latter part of this statement requires modification, for although the absolute position of the heart is changed, its position relatively to the intestine is not affected, as may be seen in the following diagrams (woodcuts, p. 276).

*Ciona* (fig. 1) shows the simplest and probably the typical condition in which the intestinal loop (*i*) is completely posterior to the branchial sac (*br*), the œsophagus and stomach descending on the dorsal side, and the intestine ascending (for a time) on the ventral side. Here the heart, being always in connexion with the stomach, is dorsal, and the intestine lies ventrally and anteriorly to it.

\* The branchial aperture is "anterior," and the oral lamina or languets "dorsal;" Hancock considered the endostyle dorsal.

Fig. 1.

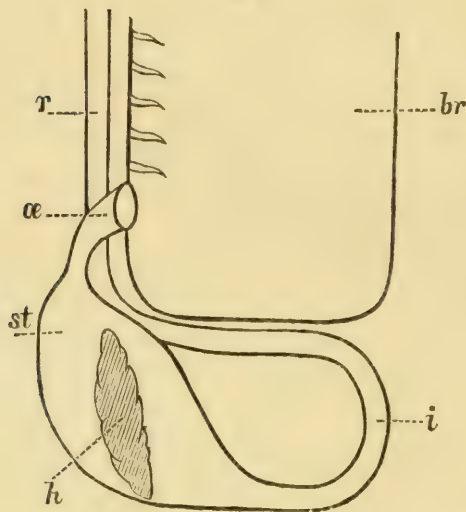


Fig. 2.

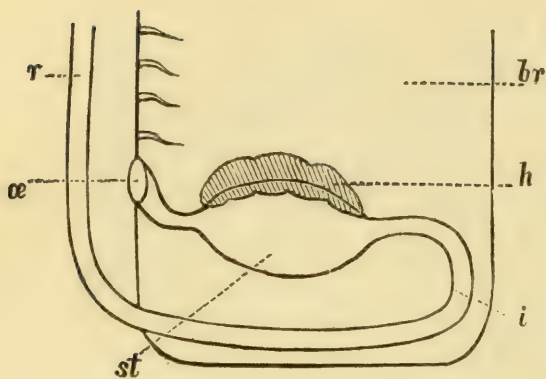
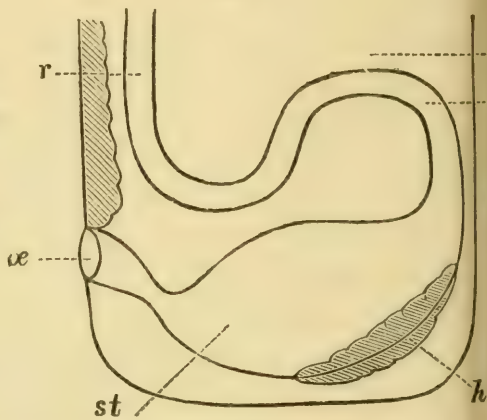


Fig. 3.



Diagrams showing course of the alimentary canal: fig. 1, in *Ciona*; fig. 2, in *Corella*; fig. 3, in *Ascidia*.  $\alpha$ , œsophagus;  $st$ , stomach;  $i$ , flexure of intestine;  $r$ , rectum;  $br$ , branchial sac;  $h$ , heart.

If we now, the mouth and anus being fixed, draw the intestinal loop ( $i$ ) directly anteriorly until the whole alimentary canal is on the *left* side of the branchial sac, we get the relation of parts characteristic of *Ascidia*, as shown in fig. 3. The heart now lies at the ventral edge of the posterior end, the intestine turns anteriorly, and is in its entire extent anterior to the heart.

If we return to fig. 1, the arrangement in *Ciona*, and again draw the intestinal loop forwards, but this time to the *right* of the branchial sac, we produce the configuration shown in fig. 2, and characteristic of *Corella*. Here the heart, having remained on the stomach-wall, has become anterior to the intestine, and is



on neither dorsal nor ventral edge, while the intestine, though still curving away from the heart, turns posteriorly instead of anteriorly.

We thus see that it is possible, by a simple change in the relation of the alimentary canal to the branchial sac, to get the very different arrangements of the viscera found in the genera *Corella* and *Ascidia* from the simpler and somewhat intermediate condition which obtains in *Ciona*. This explanation also accounts for the curious position of the heart in *Corella*, and shows that it is merely a consequence of the change in the disposition of the intestine.

Some of our British species of *Ascidia* require examination; several have been described under different names by different authors, and many have never been sufficiently characterized—a full description requiring, according to our modern ideas, an account of the condition of the branchial sac, dorsal lamina, and other internal organs, as well as of the external appearance.

The new species have been dredged, during the last three summers, on the west coast of Scotland, in Loch Long (Clyde), and in Lamlash Bay, Arran.

*ASCIDIA LATA*, n. sp. (Plate XIV. figs. 1-3.)

*External appearance.*—Shape roughly oblong, anterior end narrowest; flattened laterally; nearly erect; posterior end rounded; ventral edge convex; dorsal edge with a large rounded projection near the middle. Attached by a small oblong area at the ventral edge of the posterior end of the left side. Branchial aperture terminal or nearly so, sessile, not conspicuous; atrial aperture about halfway down, placed at the summit of the projection on the dorsal edge, not conspicuous, lobes rather indistinct. Surface smooth, but cut up by faint creases, most of which are longitudinal and on the upper (right) side; a few *Serpulæ* &c. adhering towards the posterior end. Colour yellowish grey, light at anterior end, and brownish towards posterior end and on lower (left) side. Length 9·2 centims., breadth 5·1 centims.

*Test* rather thin, thickish on the upper surface, and especially at the area of attachment. Vessels well-developed and conspicuous on the inner surface; trunks enter near the middle of the ventral edge.

*Mantle* moderately developed; musculature strong on the



right side, especially in the centre, where the bands attain a thickness of .5 millim.; sphincters not particularly strong. Mantle very thin on visceral (left) side; no muscle-bands. No ocelli visible (spirit specimen).

*Branchial sac* large, extending beyond the viscera posteriorly, longitudinally plicated. Transverse vessels wide and rather close, all one size. Meshes nearly square, the transverse extent being generally slightly the greater, with large papillæ at the angles, and slightly smaller intermediate ones on the inconspicuous internal longitudinal bars. Stigmata oblong, rather short, six to eight in a mesh. All the larger vessels bear, on their outer (atrial) sides, short, more or less spine-like projections.

*Dorsal lamina* rather narrow, ribbed transversely, margin slightly pectinated. On the right side of the branchial sac near the dorsal lamina, and a little above the œsophageal opening, there is an oval slit 1.5 centim. long; externally it opens just inside the atrial aperture.

*Tentacles* few (16 to 20), distant, and rather small, filiform.

*Olfactory tubercle* of moderate size, irregular in shape, right horn rolled outwards and left horn inwards.

*Viscera*.—Stomach large, thick-walled. Intestine with a broad typhlosole projecting from the upper (inner) side. Ovary and testis placed in the loop.

*Locality*. Upper end of Loch Long, 5 to 10 fathoms.

This species externally bears considerable resemblance to *Ascidia mentula*; it differs from it chiefly in the character of the branchial sac, the tentacles, and the olfactory tubercle (see Plate XIV. fig. 3).

#### ASCIDIA FUSIFORMIS, n. sp. (Plate XIV. figs. 4-6.)

*External appearance*.—Shape elongate-elliptical, flattened laterally; both ends narrow, anterior almost pointed, posterior more obtuse; dorsal edge rather more convex than ventral. Attached by a small area on the left side two thirds of the way down. Branchial aperture terminal and median, almost sessile; atrial on right side halfway between median line and dorsal margin, fully halfway down, sessile; lobes of both rather indistinct. Surface smooth, a few faint mostly longitudinal creases on the right side. Colour light yellowish grey, hyaline at the edges. Length 6.5 centims., breadth 3 centims.

*Test* rather thick, hyaline, transparent; vessels just visible.

*Mantle* moderately muscular on the right side.

*Branchial sac* extending beyond the viscera posteriorly, longitudinally plicated (in some parts not at all strongly); meshes square or slightly elongated transversely, with stout papillæ at the corners, and smaller intermediate more conical ones. Stigmata short, generally oval or elliptical, three in a mesh.

*Dorsal lamina* narrow, ribbed transversely, margin bluntly denticulated.

*Tentacles* small and distant, 25 to 30 in number, large and small alternately.

*Olfactory tubercle* almost quadrangular in outline; both horns coiled inwards.

*Nerve ganglion* oblong, narrow, placed nearer the atrial than the branchial aperture.

*Locality.* Upper end of Loch Long, 5 to 10 fathoms.

This species is evidently allied to *Ascidia mentula*.

One of the three specimens is a sinistral individual. The area of attachment is on the right side, and the atrial aperture is on the left. Internally, the branchial sac is placed to the left of the viscera, so that, on opening the branchial sac from the side opposite the viscera, the anterior end being uppermost, the dorsal lamina is seen on the right hand and the endostyle on the left, the reverse of the usual arrangement.

ASCIDIA VIRGINEA, *O. F. Müller.* (Plate XV. figs. 1, 2.)

*Ascidia virginea*, *O. F. Müller, Prodrromus*, p. 225. no. 2732 (1776),  
*Zool. Dan.* vol. ii. p. 12, tab. 49. fig. 4 (1780).

*Ascidia opalina*, *MacGillivray, Moll. Aberdeen*, p. 312 (1843).

*Ascidia punum*, *MacGillivray, Moll. Aberdeen*, p. 312 (1843); non  
*Müller, Zool. Dan.*

*Ascidia sordida*, *Alder, Cat. Mar. Moll. Northumb. & Durham*, in *Trans. Tynes. Nat. F. C.* vol. i. p. 199 (1850).

*Ascidia virginea*, *Alder, Cat. Mar. Moll. Northumb. & Durham*, in *Trans. Tynes. Nat. F. C.* vol. i. p. 200 (1850).

*Ascidia virginea*, *Forbes & Hanley, Brit. Moll.* vol. i. p. 33 (1853).

*Ascidia sordida*, *Forbes & Hanley, Brit. Moll.* vol. ii. p. 372 (1853).

*Ascidia virginea*, *Norman, Moll. of the Firth of Clyde, Zoologist*, vol. xv. p. 5708 (1857).

*Ascidia virginea*, *Grube, Die Insel Lussin und ihre Meeresfauna*, p. 53 (Breslau, 1864).

*Ascidia sordida*, *Hancock, Anat. & Phys. of Tun., Journ. Linn. Soc. Zool.* vol. ix. p. 309 (1868).



*Phallusia virginea*, Kupffer, *Jahresberichte d. Komm. z. Untersuch. d. deutsch. Meere in Kiel, Tunicata*, p. 210 (1874).

*Ascidia sordida*, MacIntosh, *Marine Fauna of St. Andrews*, p. 55 (1875).

*Ascidia virginea*, Heller, *Untersuch. ü. d. Tun. d. Adriat. u. Mittelm.* ii. Abth., p. 7 (1875).

*Phallusia virginea*, Traustedt, *Oversigt o. d. f. Danmark, &c., Asc. simp.* p. 45, in *Vid. Medd. Nat. For., Kjöbenhavn* (1880).

M. Traustedt, in a paper published last summer, on the Simple Ascidiæ from the coast of Denmark &c., has placed *Ascidia sordida* of Alder and Hancock as a synonym of *Ascidia virginea*. In this I quite agree with him. A comparison of the descriptions of *A. sordida* by Alder and of *A. virginea* by Kupffer and Heller leaves no room to doubt that they are the same species. It is rather curious, however, that Alder should have both names in his catalogue; he does not in his description of *A. sordida*, as a new species, refer to *A. virginea* at all.

A few points in regard to the characteristics of the species still require to be discussed. The external appearance has been fully described, especially by Alder and Heller. In regard to the branchial sac, the absence of papillæ (see Pl. XV. fig. 1) has been noticed by Alder, Kupffer, and Traustedt, while Heller states that the internal longitudinal bars are provided with small three-cornered papillæ. I have figured (Pl. XV. fig. 2) a small portion of the branchial sac seen from the outside, to show the appearance presented by the longitudinal plication. The dorsal fold is always described as ribbed transversely and smooth-edged. In specimens from the Firth of Forth, however, where what was described by Alder as *Ascidia sordida* is very common in 4 and 5 fathoms, the margin is slightly but distinctly toothed, there being several smaller denticulations between each pair of larger ones, which are opposite the ends of the ribs. The tentacles are described as being closely packed and about fifty in number. This is considerably under what I have observed, which has generally been about ninety; they are rather slender, and are of two sizes placed alternately.

*ASCIDIA TRUNCATA*, n. sp. (Plate XV. figs. 3-6.)

*External appearance.*—Shape oblong, nearly quadrangular, flattened laterally; anterior end truncated, slightly narrower than the almost straight posterior end; dorsal and ventral edges nearly straight and parallel. Attached by a narrow transverse



area at the left side of the posterior end. Apertures both on right side; branchial terminal, placed at the dorsal extremity of the anterior end, and turned dorsally; atrial close to the branchial, and directly posterior to it, being on the right side, close to the dorsal edge, and about one fifth of the way down. Both apertures slightly projecting, tubular, rather wide; atrial more distinctly and regularly lobed than branchial. Surface rough and irregular, especially on the posterior half of the right side. Several foreign bodies adhering at the base, and some specimens of *Modiolaria marmorata* imbedded in the anterior half of the right side. Lobes of apertures finely echinated. Colour yellowish grey to dark brown. Length 6·8 centims., breadth 4 centims.

*Test* moderately thick, tough; inner surface smooth, with a bluish tinge; no vessels visible.

*Mantle* well developed; muscle-bands strong, but rather distant on the right side and round the edges of the left; entirely wanting over the visceral mass, where the mantle is membranous.

*Branchial sac* longitudinally plicated; every third or fourth transverse vessel larger and more muscular than the intermediate ones. Internal longitudinal bars well marked, borne on long curved ducts, and bearing very small papillæ, which merely form slight thickenings at the angles of the meshes. Meshes rather elongated transversely; stigmata short, elongate-elliptical, six to eight in a mesh.

*Dorsal lamina* broad, ribbed transversely, and slightly pectinated at the margin.

*Tentacles* rather large and strong, 32 in number, longer and shorter alternating.

*Olfactory tubercle* regular, broadly heart-shaped; both horns coiled inwards.

*Viscera* reaching as far posteriorly as the base of the branchial sac.

*Locality.* Upper end of Loch Long, 5 to 10 fathoms.

This species is probably allied to *A. virginica*.

*ASCIDIA ASPERSA*, O. F. Müller. (Plate XVI. figs 1-3.)

*Ascidia aspersa*, O. F. Müller, *Prodromus*, p. 225. no. 2728 (1776);

*Zool. Dan.* ii. p. 33, tab. 65. fig. 2 (1780).

*Ascidia mamillaris*, *Delle Chiaje*, *Mem. degli anim. di Napoli*, vol. ii. p. 197, tab. xlv. fig. 14 (1823).

*Phallusia cristata*, *Risso*, *Hist. nat. d. prod. de l'Eur. mérid.* t. iv. p. 276 (1826).

- Ascidia aspersa*, Forbes & Hanley, *Brit. Moll.* vol. i. p. 35 (1853).  
*Ascidia cristata*, Grube, *Ausflug nach Triest &c.*, p. 65, tab. ii. fig. 8 (1858).  
*Ascidia pustulosa*, Alder, *Ann. & Mag. Nat. Hist.* ser. 3, vol. xi. p. 154 (1863).  
*Ascidia aculeata*, Alder, *Ann. & Mag. Nat. Hist.* ser. 3, vol. xi. p. 156 (1863).  
*Ascidia cristata*, Grube, *Die Insel Lussin und ihre Meeresfauna*, p. 53 (1864).  
*Ascidia aspersa*, Alder, *Hebrid. Invert.*, *Brit. Assoc. Rep. for 1866*, p. 207 (1867).  
*Phallusia pustulosa*, Kupffer, *Jahresberichte d. Komm. z. Untersuch. d. deutsch. Meere in Kiel, Tun.* p. 213 (1874).  
*Ascidia cristata*, Heller, *Untersuchungen ü. d. Tun. Adriat. u. Mittelm.* 1 Abth. p. 16, Taf. vi. figs. 5-12 (1874).  
*Phallusia aspersa*, Traustedt, *Oversigt o. d. f. Danmark &c.*, *Asc. simp.* p. 43 (1880).

This species varies somewhat in external appearance according to its age, and there can be no doubt that Alder's *A. pustulosa* and *A. aculeata* are merely the old and young stages. Grube suggests that Delle Chiaje's *Ascidia mamillaris* is a young specimen of this species; and the figure certainly closely resembles some small specimens of *A. aculeata* from Lamash Bay. Heller gives, under the name of *A. cristata*, an excellent account of this species; it has also been well described as *Phallusia pustulosa* by Kupffer, and as *Ascidia aspersa* by Traustedt; in some of the internal characters, however, there is a certain want of agreement between the various descriptions. In regard to the branchial sac, Alder says that *A. pustulosa* has small papillæ, and *A. aculeata* has papillæ and elliptical stigmata. Heller's description of the branchial sac is good; he refers to the longitudinal plication (like that in *Ascidia mentula*), the long connecting ducts, and the very small papillæ. Kupffer, strange to say, mentions long papillæ, equalling in length the breadth of the meshes; he may have confused them with the long connecting ducts. In all the specimens I have examined (from Lamash Bay and Loch Long) the papillæ were very small, and, except when seen in profile, appeared as mere thickenings of the internal longitudinal bars; the meshes were small and nearly square, containing each four to six rather short stigmata (Pl. XVI. fig. 1).

The dorsal lamina, correctly described by Heller, is transversely ribbed, and has the margin finely but irregularly denticulated



(Pl. XVI. fig. 2). Alder states that it is smooth, and Kupffer and Traustedt mention the ribs, but refer to the edge as smooth.

The tentacles (Pl. XVI. fig. 3), which in my specimens are small and slender, rather distantly placed, 32 in number, and of three sizes alternating (eight large-, eight medium-, and sixteen small-sized), are described by Alder in *A. pustulosa* as few and stout, while Kupffer and Traustedt say that they number fifty or more; their relative size and arrangement is not referred to in any of the descriptions.

*ASCIDIA TRIANGULARIS*, n. sp. (Plate XVI. figs. 4-7.)

*External appearance*.—Shape triangular, not compressed; anterior end narrow, forming a rounded point; posterior end wide, straight, elongated dorso-ventrally; ventral edge almost straight, dorsal sloping backwards to join the rounded dorsal edge of the posterior end. Attached by the entire extent of the posterior end, and the ventral half of the posterior end of the right side. Branchial aperture terminal, sessile; lobes regular and distinct, but not projecting; atrial aperture on dorsal edge, one third of the way down, slightly projecting, directed dorsally and posteriorly. Surface prickly, covered with minute pointed projections all over, except on the centre of the left side, and at the anterior end round the branchial aperture. Colour light grey; when living the apertures were slightly pink. Length 2.3 centims., breadth (at posterior end) 2 centims.

*Test* rather thin and soft, but moderately strong, transparent. Course of intestine seen through distinctly from left side.

*Mantle* delicate, adhering slightly to inner surface of test; musculature distinct but fine.

*Branchial sac* a little irregular, but not longitudinally plicated. The alternate transverse vessels wider than the intermediate ones. Internal longitudinal bars distinct and strong, borne on long ducts; no papillæ. Meshes almost square, containing each about six stigmata.

*Dorsal lamina* transversely ribbed; margin minutely denticulated, three or four denticulations between each pair of ribs.

*Tentacles* rather small and distant, 15 larger, and nearly the same number of small intermediate ones; in some spaces the intermediate one is absent.

*Olfactory tubercle* irregularly lozenge-shaped, opening anterior; horns bent in, but not coiled.



*Viscera*.—Stomach distinct, nearly globular; intestine rather long and narrow.

*Locality*. Lamlash Bay, 10 to 20 fathoms.

This species comes near *Ascidia aspersa*. In some parts of the branchial sac (Pl. XVI. fig. 6) there is an irregularity and want of continuity in the internal longitudinal bars; the same condition is seen frequently in *Corella parallelogramma*.

ASCIDIA SCABRA, O. F. Müller. (Plate XVI. fig. 8; Plate XVII. figs. 1-3.)

*Ascidia scabra*, O. F. Müller, *Prodromus*, p. 225. no. 2726 (1776), *Zool.*

*Dan.* ii. p. 33, tab. 65. fig. 3 (1780); *Forbes & Hanley, Brit. Moll.* vol. i. p. 33 (1853).

*Phallusia scabra*, Grube, *Die Insel Lussin &c.* p. 55 (1864).

*Ascidia scabra*, Hancock, *Anat. and Phys. of Tun., Journ. Linn. Soc. Zool.* vol. ix. p. 309 (1868).

*Ascidia scabra*, Heller, *Untersuchungen ü. d. Tun. Adriat. u. Mittelm.* 1 Abth. p. 17, Taf. vi. fig. 13 (1874).

As far as I am aware only the external appearance of this species has been described; the following will complete what is necessary for the proper definition of the species.

*Branchial sac* longitudinally plicated; transverse vessels usually all of the same size, occasionally, however, slighter intermediate ones are present for short distances. Internal longitudinal bars distinct, but having no papillæ. Meshes usually transversely elongated, each containing about twelve stigmata.

*Dorsal lamina* broad, ribbed transversely; margin finely but irregularly toothed, five to seven teeth between each pair of ribs.

*Tentacles* of three lengths, 18 long and rather slender, the same number of shorter intermediate ones, and about 36 very short ones, regularly disposed between the others.

*Olfactory tubercle* simply oval in outline, the opening at the anterior end; horns not coiled.

*Ascidia scabra* is allied to both *A. aspersa* and *A. virginea*. I have figured (Plate XVII. fig. 3) a small part of the branchial sac of one of my specimens, to show the amount of irregularity which may occur; it is seen from the outer side so as to avoid the additional complication which the presence of the internal longitudinal bars would introduce.

ASCIDIA PATONI, n. sp. (Plate XVII. figs. 4-7.)

*External appearance*.—Shape elongate-elliptical; anterior end narrow, posterior rounded; dorsal edge more convex than ven-

tral; left side flat, right slightly convex. Attached by posterior end of left side towards ventral edge; the area of attachment forms a well-marked base, almost a short stalk, with the posterior margin slightly expanded. Both apertures on right side, sessile; branchial almost terminal; atrial about one fourth of the way down, near the dorsal edge. Surface smooth. Colour light yellowish grey. Length 6 centims., breadth 3 centims.

*Test* thin, but tough; vascular trunks enter in the lower third of the left side (at the anterior end of the base), and radiate over that side, where they are conspicuous.

*Mantle* rather thin; muscle-bands fine, but numerous.

*Branchial sac* delicate, not longitudinally plicated; the alternate transverse vessels are stronger than the intermediate ones; in some places, however, the latter are wanting. The internal longitudinal bars bear large curved papillæ, those at the intersections with the slighter transverse vessels, or where these ought to be, smaller than the others. Meshes slightly longer transversely than vertically; stigmata short and regular, six to eight in a mesh.

*Dorsal lamina* closely ribbed transversely; margin toothed, rather irregularly.

*Tentacles* very numerous, packed closely together, of at least three sizes, the smallest being very minute.

*Olfactory tubercle* simply ovate in outline, the opening anterior.

*Locality.* Upper end of Loch Long, 5 fathoms.

For this and a few of the other specimens I am indebted to my friend Mr. D. Noel Paton, B.Sc., to whom this species is dedicated.

*ASCIDIA MURICATA, Heller.* (Plate XVIII. figs. 1, 2.)

*Ascidia muricata, Heller, Untersuchungen ü. d. Tun. d. Adriat. u. Mittelm.* 1 Abth. p. 13, Taf. iv. figs. 6-7 & Taf. v. fig. 1 (1874).

This species, which was found by Heller at Lesina, I dredged twice in Lamlash Bay last September. The specimens were small, being only half the size of those from the Mediterranean, but agree well with the description and figures. Heller gives a full account of the external appearance; but for the internal characters merely says that the form of the branchial sac, the papillæ, and the dorsal fold are like those of *Ascidia mentula*. I therefore add the following details taken from the Scottish specimens.

*Branchial sac* not longitudinally plicated, or very slightly so;



transverse vessels all one size, rather far apart. Internal longitudinal bars strong and numerous, bearing large irregularly shaped papillæ at the angles of the meshes, and smaller conical intermediately placed ones. Meshes having the vertical extent nearly twice as great as the horizontal, each containing two or three stigmata.

*Dorsal lamina* rather broad, strongly ribbed transversely, margin plain.

*Tentacles* rather large, placed close together, long and short alternately, about 12 of each size.

*Olfactory tubercle* simple, opening anterior, horns not coiled.

ASCIDIA OBLIQUA, *Alder*. (Plate XVIII. fig. 3.)

*Ascidia obliqua*, *Alder*, *Ann. & Mag. Nat. Hist.* 3rd ser. vol. xi. p. 154 (1863).

In the collection at the Natural-History Rooms in the Edinburgh University there are two specimens of this species from Lofoten, 300 fathoms, identified by Professor M. Sars; they agree perfectly with Alder's description of British specimens (Lamlash). Those, on the other hand, described and figured by Heller (*Untersuch. &c.*, 1 Abth. p. 13, Taf. iv. fig. 5) are undoubtedly a distinct species.

Alder gives a good description of the external appearance; an account of a few points in the internal structure is still wanting.

*Branchial sac* delicate, longitudinally plicated. Internal longitudinal bars thin but distinct, bearing papillæ at the corners of the meshes; these papillæ are rod-like in profile, but bear membranous expansions, which are seen in the lateral view. Meshes slightly longer vertically than transversely, each containing about six elongated regular stigmata.

*Dorsal lamina* transversely ribbed.

*Tentacles* numerous, slender.

*Olfactory tubercle* cordate.

ASCIDIA DEPRESSA, *Alder & Hancock*. (Plate XVIII. figs. 4, 5.)

*Ascidia depressa*, *Alder*, *Catalogue of the Marine Mollusca of Northumberland and Durham*, in *Trans. Tynes. Nat. F. C.* vol. i. p. 201 (1850); *Forbes and Hanley*, *British Mollusca*, vol. ii. p. 373 (1853); *Alder*, *Hebrid. Invert.*, *Brit. Assoc. Rep. for 1866*, p. 208 (1867); *Heller*, *Untersuch. ü. d. Tun. d. Adriat. u. Mittelm.* 1 Abth. p. 15, Taf. v. figs. 10-12 (from *Denksch. d. k. Akad. d. Wiss.* Bd. xxxiv., Wien, 1874) *MacIntosh*, *Marine Fauna of St. Andrews*, p. 55 (1875).



This species has such a characteristic appearance that no addition to Alder's description is necessary. No account of its internal characters, however, has been given—Alder merely saying "Branchial sac finely reticulated, with tubercles at the intersections," and Heller giving no information beyond the external appearance. This being the case, the following notes on the condition of the branchial sac &c. are necessary to complete the description of the species.

*Branchial sac* long and narrow, generally extending beyond the viscera posteriorly, longitudinally plicated; transverse vessels all one size. Meshes square or slightly elongated transversely, with short blunt papillæ at the corners, and smaller intermediate ones on the internal longitudinal bars. Stigmata elongate-elliptical, rather short, four or five in a mesh.

*Dorsal lamina* strong, not very wide, transversely ribbed; margin provided with short teeth opposite the ends of the ribs and generally one or two smaller intermediate ones.

*Tentacles* simple, tapering, and slightly curved, numerous and closely placed, about 15 to 20 longer and stouter, between each pair of which are one or two small ones.

*Olfactory tubercle* simple, oval in outline, with the opening at the anterior slightly narrower end.

*Viscera* in a compact mass, occupying the posterior half of the left side of the branchial sac.

*Locality.* Attached to the under surfaces of large stones at extreme low water, near King's Cross Point, Lamlash Bay.

*ASCIDIA PLEBEIA, Alder.* (Plate XVIII. figs. 6-8; Plate XIX. figs. 1-4.)

*Ascidia plebeia, Alder, Ann. & Mag. Nat. Hist. ser. 3, vol. xi. p. 155 (1863); Alder, Hebrid. Invert., Brit. Assoc. Rep. for 1866, p. 207 (1867); Heller, Untersuch. ü. d. Tun. Adriat. u. Mittelm. 1 Abth. p. 14, Taf. v. fig. 7 (1874).*

This is a rather variable species, showing very different appearances according to its position and the objects to which it is attached; it also varies greatly in the amount to which it is covered by sand, shells, and other foreign bodies. Alder says "slightly covered with fragments of shell and sand at the attached end." Some of my specimens from Lamlash Bay have the soft dull-green test entirely exposed, while others are completely covered, even on the siphons in some cases, by a fine, but thick

coating of sand-grains, and in others by large pieces of shell, nullipore, and stones. Heller's figure is fairly characteristic; in many of my specimens, however, the atrial siphon is directed more posteriorly than dorsally, and is not so prominent.

I figure a specimen with the test removed (Pl. XIX. fig. 1), to show the elongated atrial siphon.

The characters of the internal organs are as follows:—

*Branchial sac* oblong, not longitudinally plicated, or only very slightly so. Transverse vessels stout, all the same size. Internal longitudinal bars conspicuous, bearing large papillæ at the angles of the meshes, and smaller, more conical intermediate ones; these latter are absent in a few of the meshes. Meshes slightly longer vertically than transversely, each containing three to five rather short stigmata.

*Dorsal lamina* transversely ribbed, margin minutely denticulated.

*Tentacles* inconspicuous, very slender, 72 in number, of three sizes arranged alternately—18 large, 18 medium-sized, and 36 small.

*Olfactory tubercle* oblong in outline, the opening at the anterior end of the right side; horns almost touching, not coiled.

This species comes near *Ascidia depressa*, Alder.

The condition of the olfactory tubercle described above (and figured on Pl. XVIII. fig. 7) is the one usually found; but in some specimens the horns are turned in (as shown on Pl. XVIII. fig. 6) but not coiled. In some parts of the dorsal lamina (see Pl. XIX. fig. 3) a series of papillæ is present, forming a line parallel to and resembling the denticulated margin.

ASCIDIA EXIGUA, n. sp. (Plate XIX. figs. 5-8.)

*External appearance*.—Shape ovate-elliptical, anterior end slightly wider than posterior, both blunt and rounded; depressed, flattened laterally. Attached by the entire left side; margin slightly expanded here and there. Apertures both sessile, inconspicuous; branchial terminal, atrial about two fifths of the way down. Surface smooth. Colour yellowish grey. Length 1.1 centim., breadth 0.6 centim.

*Test* moderately thick, strong, transparent; no vessels visible.

*Mantle* well developed; muscular bands very delicate, but close, forming rather a fine network. Ocelli red, minute.

*Branchial sac* not longitudinally plicated, meshes having the

vertical extent greatest, with large conical papillæ at the corners and no intermediate ones. Stigmata oblong with rounded ends, usually two in a mesh.

*Dorsal lamina* ribbed transversely; margin irregularly pectinated.

*Tentacles* numerous, placed close together, about 20 large and the same number of rather small intermediate ones.

*Olfactory tubercle* irregularly U-shaped; opening anterior, wide.

*Viscera* rather small, seen distinctly through mantle on left side.

Stomach large, yellow. Intestine narrow, black.

*Locality.* Lamash Bay, 10 fathoms, Sept. 1879.

P.S.—In connection with the irregular branchial sac of *Ascidia scabra* (see Pl. XVII. fig. 3) mentioned on page 284, I have unfortunately omitted to refer to Lacaze-Duthiers' interesting description of three varieties in the branchial sac of *Ctenicella Lanceplaini* (Arch. Zool. expér. vol. vi. p. 619, 1877). But I hope to return to this subject in a future communication.

#### EXPLANATION OF THE PLATES.

##### PLATE XIV.

- Fig. 1. *Ascidia lata*, n. sp. Seen from the right side, natural size.  
 2. The same. Part of branchial sac, seen from inside, magnified.  
 3. The same. Olfactory tubercle, magnified.  
 4. *Ascidia fusiformis*, n. sp. Seen from the right side, natural size.  
 5. The same. Part of branchial sac, from the inside, magnified.  
 6. The same. Olfactory tubercle, magnified.

##### PLATE XV.

- Fig. 1. *Ascidia virginea*, O. F. Müller. Part of branchial sac, seen from inside, magnified.  
 2. The same. Part of branchial sac, seen from outside, magnified.  
 3. *Ascidia truncata*, n. sp. Seen from right side, natural size.  
 4. The same. Part of branchial sac, seen from inside, magnified.  
 5. The same. Olfactory tubercle and tentacles, magnified.  
 6. The same. Part of dorsal lamina, magnified.

##### PLATE XVI.

- Fig. 1. *Ascidia aspersa*, O. F. Müller. Part of branchial sac, seen from inside, magnified.  
 2. The same. Part of dorsal lamina, magnified.  
 3. The same. Olfactory tubercle and tentacles, magnified.  
 4. *Ascidia triangularis*, n. sp. Seen from right side, natural size.



- Fig. 5. The same. Seen from left side, natural size.  
 6. The same. Part of branchial sac, from inside, magnified.  
 7. The same. Olfactory tubercle and tentacles, magnified.  
 8. *Ascidia scabra*, O. F. Müller. Part of branchial sac, from inside, magnified.

## PLATE XVII.

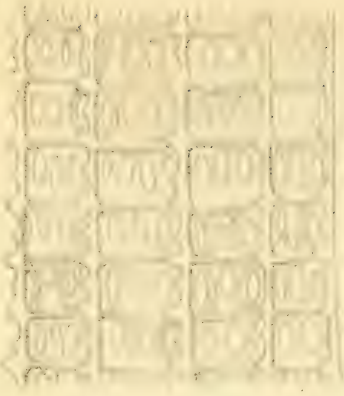
- Fig. 1. *Ascidia scabra*, O. F. Müller. Olfactory tubercle, magnified.  
 2. The same. Part of circling of tentacles, magnified.  
 3. The same. A very irregular part of branchial sac, from outside, magnified.  
 4. *Ascidia Patoni*, n. sp. Seen from the right side, natural size.  
 5. The same. Seen from ventral edge, natural size.  
 6. The same. Part of dorsal lamina, magnified.  
 7. The same. Part of branchial sac, from inside, magnified.

## PLATE XVIII.

- Fig. 1. *Ascidia muricata*, Heller. Part of branchial sac, from outside, magnified.  
 2. The same. Olfactory tubercle and tentacles, magnified.  
 3. *Ascidia obliqua*, Alder. Part of branchial sac, from inside, magnified.  
 4. *Ascidia depressa*, Alder. Part of branchial sac, from inside, magnified.  
 5. The same. Olfactory tubercle and tentacles, magnified.  
 6. *Ascidia plebeia*, Alder. Olfactory tubercle, magnified.  
 7. The same. Another variety of olfactory tubercle, magnified.  
 8. The same. A third variety of olfactory tubercle, magnified.

## PLATE XIX.

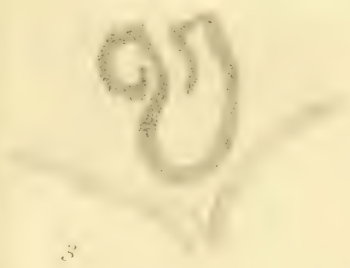
- Fig. 1. *Ascidia plebeia*, Alder. Specimen with test removed, from right side, natural size.  
 2. The same. Part of branchial sac, from inside, magnified.  
 3. The same. Part of dorsal lamina, magnified.  
 4. The same. Part of circling of tentacles, magnified.  
 5. *Ascidia exigua*, n. sp. Seen from right side, natural size.  
 6. The same. A specimen with test removed, from left side, natural size.  
 7. The same. Part of branchial sac, from inside, magnified.  
 8. The same. Olfactory tubercle, magnified.
-



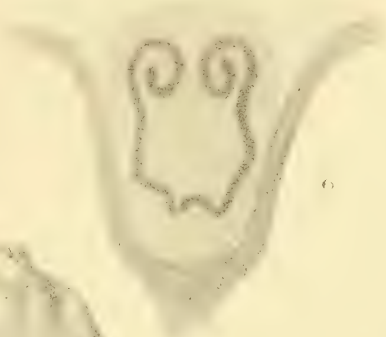
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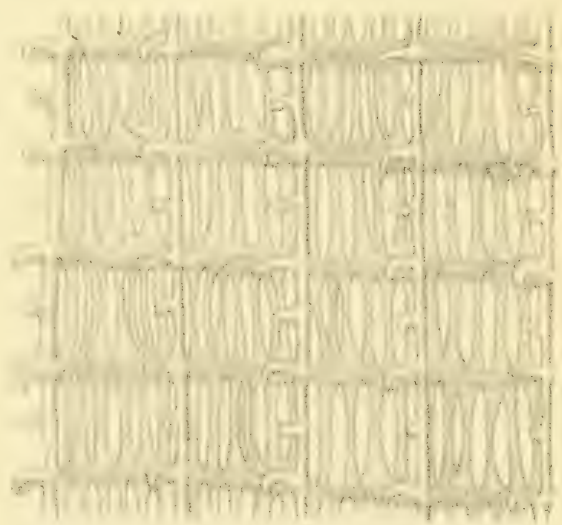
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3.



4.



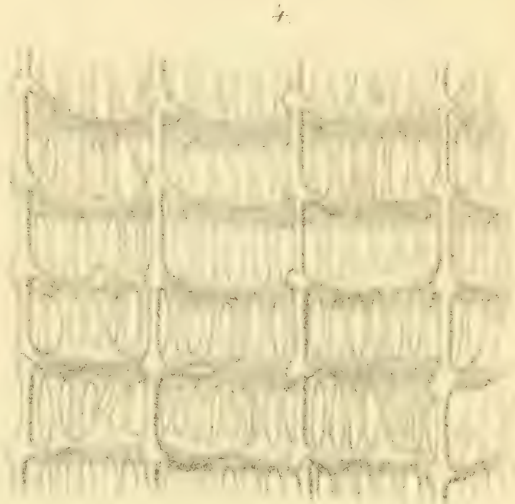
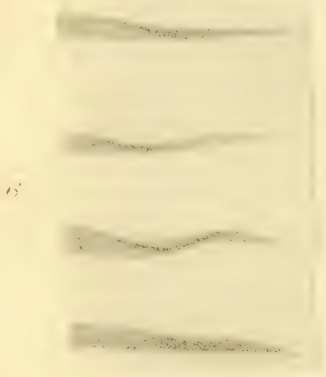
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W. A. Herdman del.

F. Huth, lith. Edin.

1-3. ASCIDIA LATA. n. sp. 4-6. A. FUSIFORMIS. n. sp.

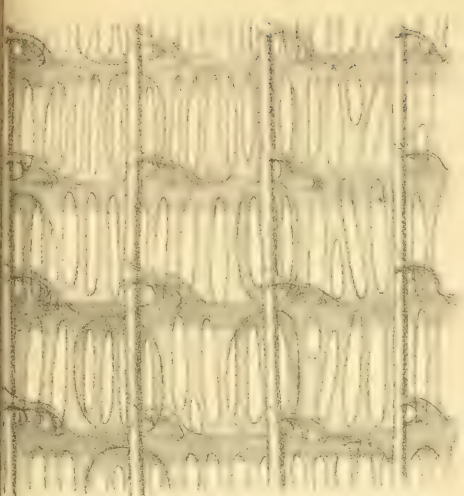




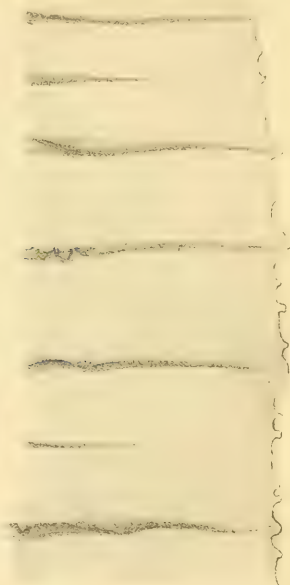
W.A. Herdman del.

F. Hutch, Lithr. Edinr.

1-2. ASCIDIA VIRGINEA. OF Müller. 3-6. A. TRUNCATA. n. sp.



1.



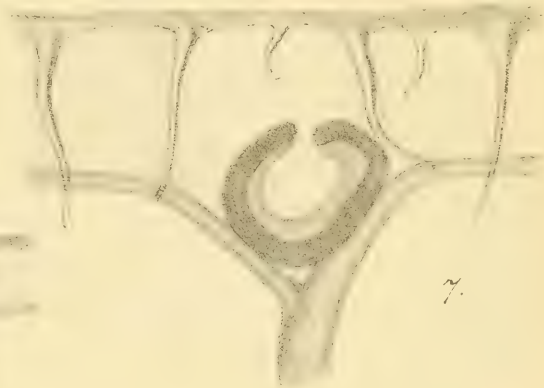
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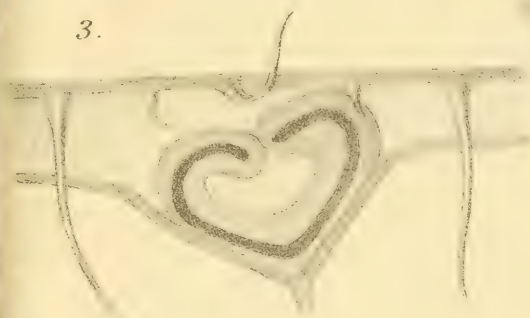
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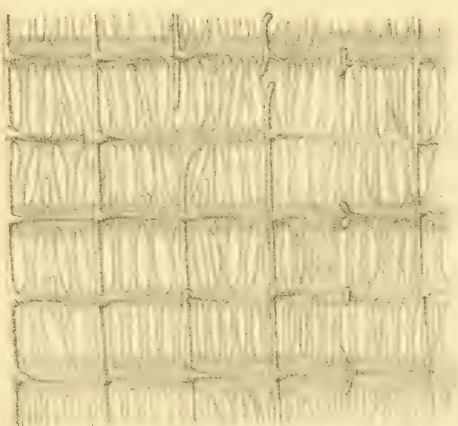
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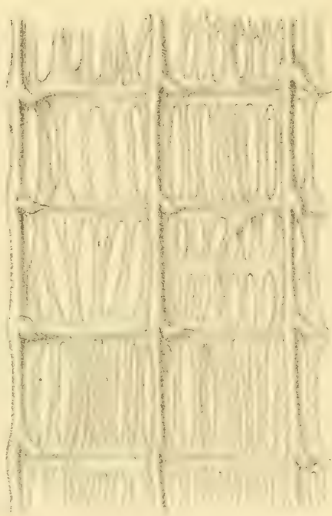
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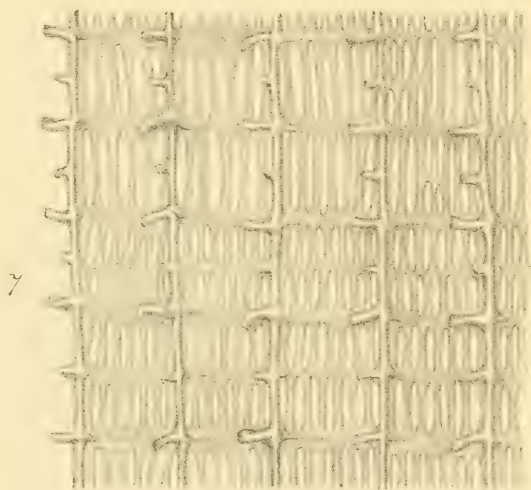
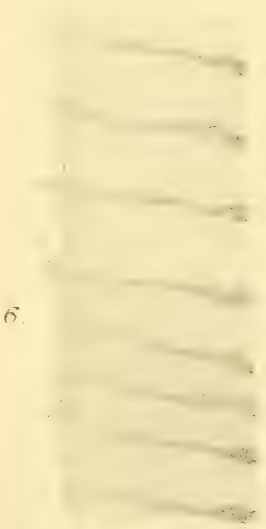
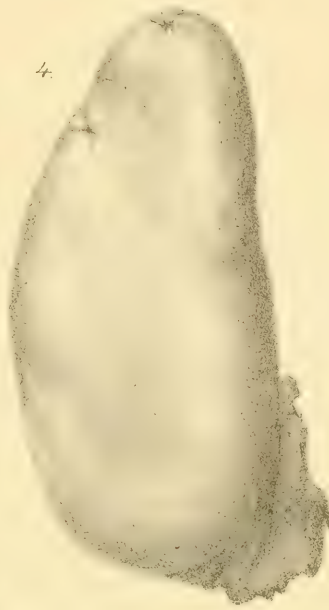
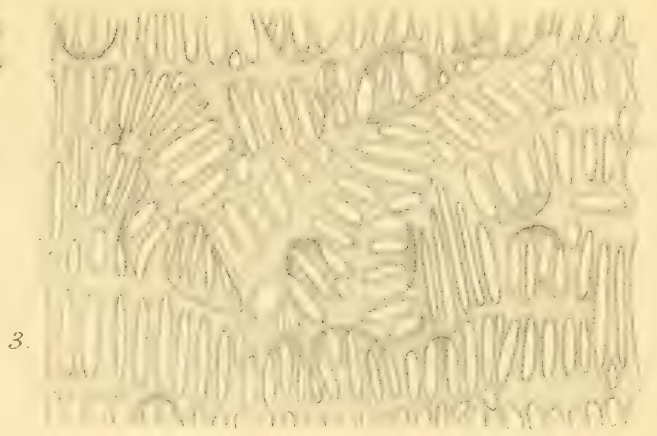
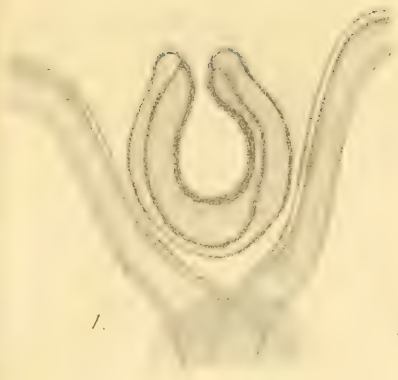
8.

W.A. Herdman, del.

F. Huth, Lith. Edin.

1-3 ASCIDIA ASPERSA. O.F. Müller.  
4-7. A. TRIANGULARIS n. sp. 8. A. SCABRA. O.F. Müller.

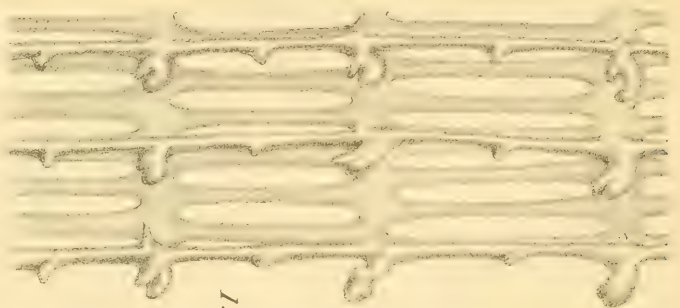




W.A.Herdman del.

F.Huth, Lithr Edinr

1-3. ASCIDIA SCABRA. O.F.Müller. 4-7. A. PATONI. n.sp.

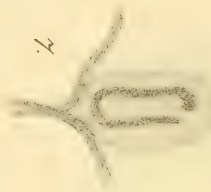


1.



6.

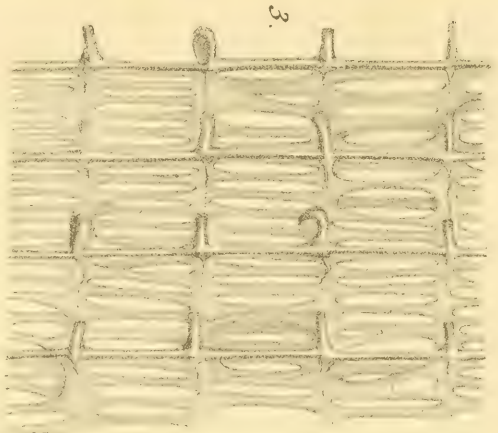
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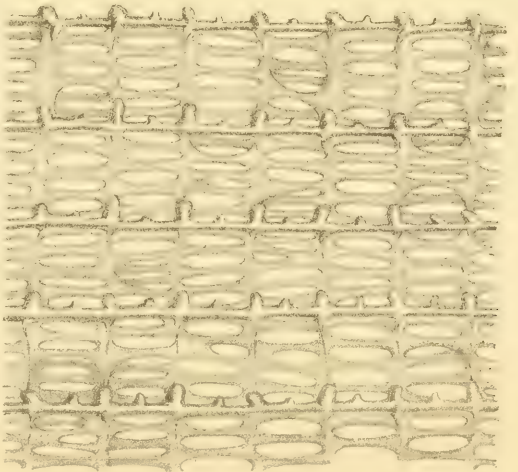
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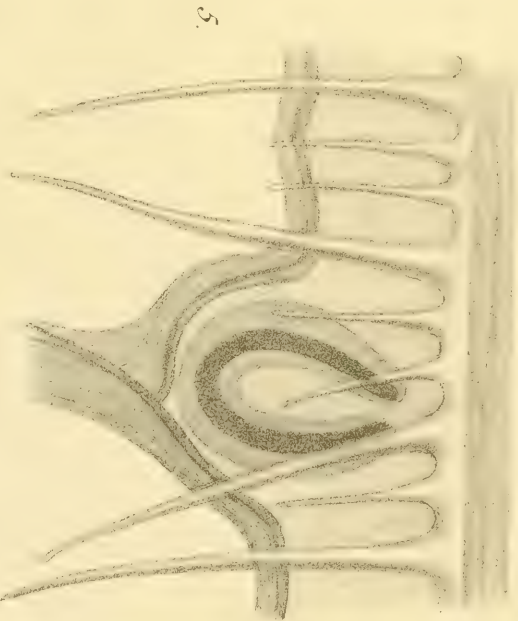
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W. A. Howman del.

F. Hahn lith. Edin<sup>r</sup>

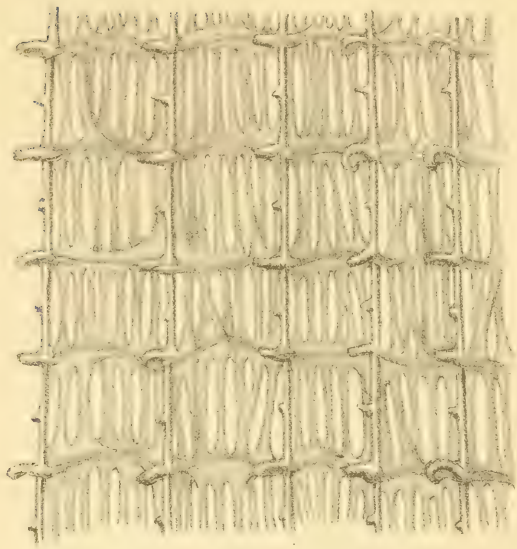
1-2. ASCIDIA MURICATA, Heller: 3. A. OBLIQUA, Alder.

4-5. A. DEPRESSA, Alder: 6-8. A. PLEBEIA, Alder.

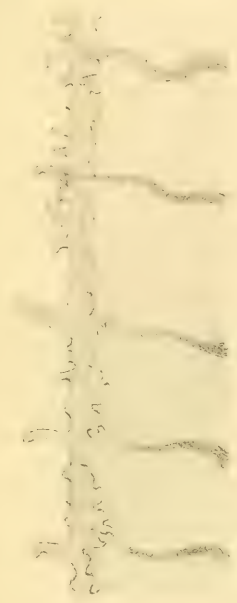




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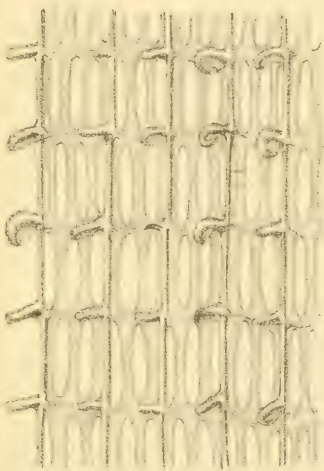
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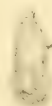
7.



5.



6.



8.

